27. SEX RATIO OF HILLSTREAM SNOW TROUT, *SCHIZOTHORAX PLAGIOSTOMUS* HECKEL (TELEOSTEI, CYPRINIDAE) IN THE UPLAND RIVER MANDAKINI OF GARHWAL HIMALAYA

(With two text-figures)

Sex ratio changes are used as an indicator of population behaviour, catch composition and fecundity. Considering its importance, little information on this aspect is available for Indian fishes (Pantulu 1961, Bhatt 1993, Nautiyal 1994). The present study is an attempt to describe the sex ratio of an economically important and dominant snow trout species *Schizothorax plagiostomus* Heckel in relation to three water parameters (total water discharge, water velocity and water temperature) of the glacier-fed upland river Mandakini in Chamoli dist. of Garhwal Himalaya, Uttar Pradesh.

Adult *S. plagiostomus* were collected from the glacier-fed high altitude Mandakini river, covering a stretch of about 30 km (Fig. 1). Specimens were randomly sampled every month from January 1991 to December 1992 at four sites - Bheri (1020 m), Chandrapuri (827 m), Agustmuni (760 m) and Tilwara (724 m). In view of its breeding twice a year, catch data of *S. plagiostomus* had been computed in terms of sex, breeding and non-breeding season. The numerical figures of males and females, during breeding and non-breeding season, are first pooled together and then separately expressed as a percentage of the total catch of each year. The ratio of M : F (M - number of males, and F - number of females) during different seasons denotes the corresponding sex ratio.

The water condition parameters of river Mandakini, *viz.*, total water discharge (m^3/ sec), water velocity (m/sec) and water temperature (0°C), during corresponding study period, obtained from U.P. Irrigation Department Srinagar Garhwal (as measured at Chandrapuri, Fig. 1), were converted into mean monthly values for the corresponding seasons.

We studied 4601 adults (3110 males and 1491 females) caught at four sampling sites. Sample size, as expressed in percentage of total catch during two years, does not indicate any relationship with sex ratio (Fig. 2).

S. plagiostomus breeds twice a year, clearly intercepted by well defined non-breeding season:- first March, April and May, and second August, September and October. During the study period, a consistent pattern of sex ratio change in *S. plagiostomus* was observed. It was found as 2.66:1 (January, February 1991), 2.29:1 (March, April, May 1991), 2.24:1 (June, July 1991), and the lowest value of one breeding cycle 2.03:1 (August, September, October 1991; second breeding season). It again rose to 2.90:1 (November, December 1991, January, February 1992), 2.28:1 (March, April, May 1992; first breeding season), 2.16:1 (June, July 1992), and again the lowest 1.59:1 (August, September, October; second breeding season) followed by an abrupt rise 2.35:1 (November, December 1992). It is, therefore, evident that males predominate the adult population of *S. plagiostomus*. The sex ratio remains higher during the first breeding season (March, April and May) and lowest during second breeding season (August, September and October) (Fig. 2).

The water condition parameters have their own bearing on the sex composition of *S. plagiostomus*. Adult males comprised the lowest sex ratio when monthly mean values of water parameters were at their peak - total water discharge (155.34 m^3/sec., 170.63m^3/sec.), water velocity (1.805m/sec., 1.919m/sec.) and water temperature (15.05°C, 15.8°C) during second breeding season (August, September, October 1991 and 1992 respectively). Higher values of sex ratio were found during first breeding season (March, April, May 1991 and 1992 respectively) when mean monthly values of water condition parameters of river Mandakini just commenced a rising trend from the lowest monthly mean

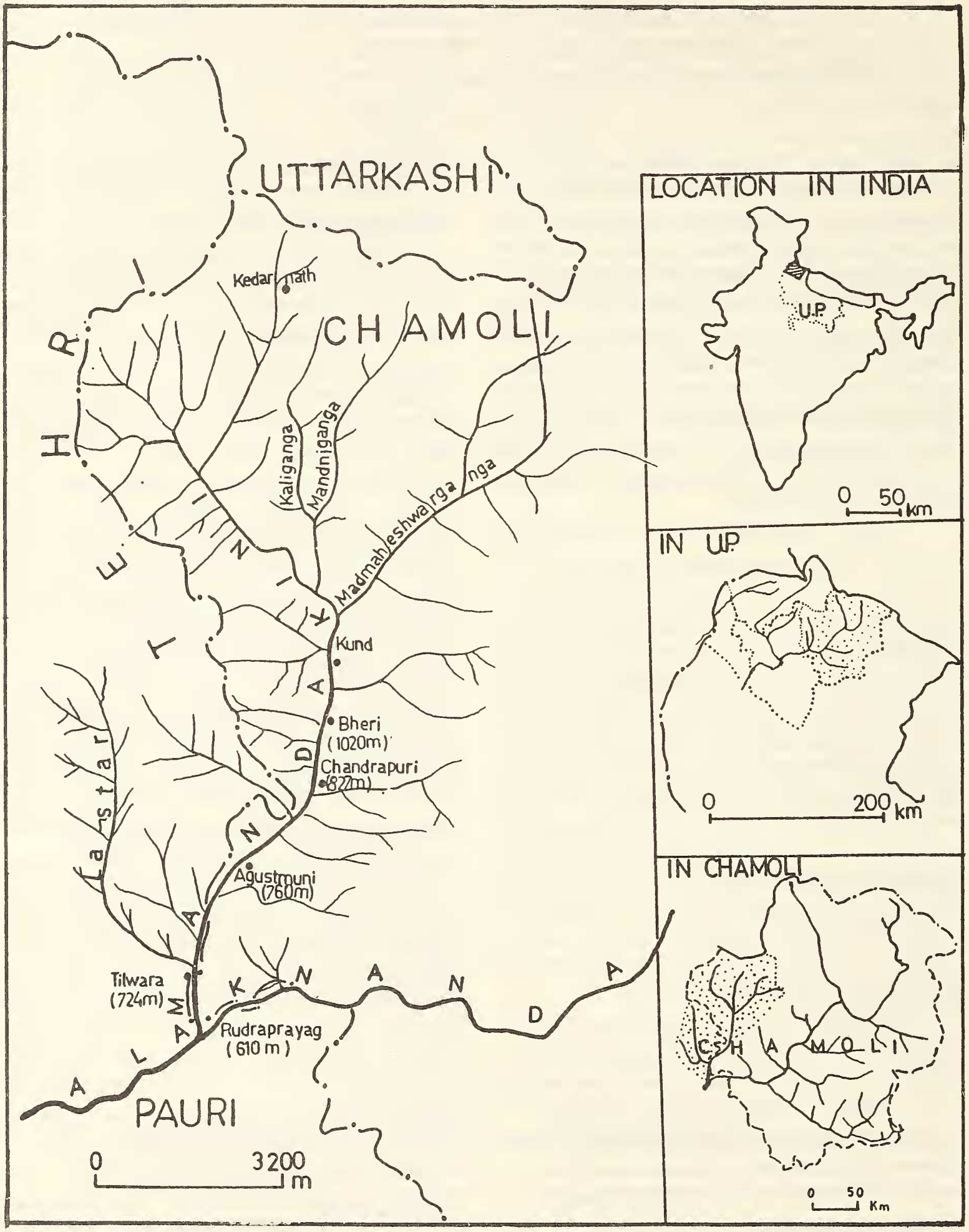

Fig. 1. Location of the sampling sites on the river Mandakini

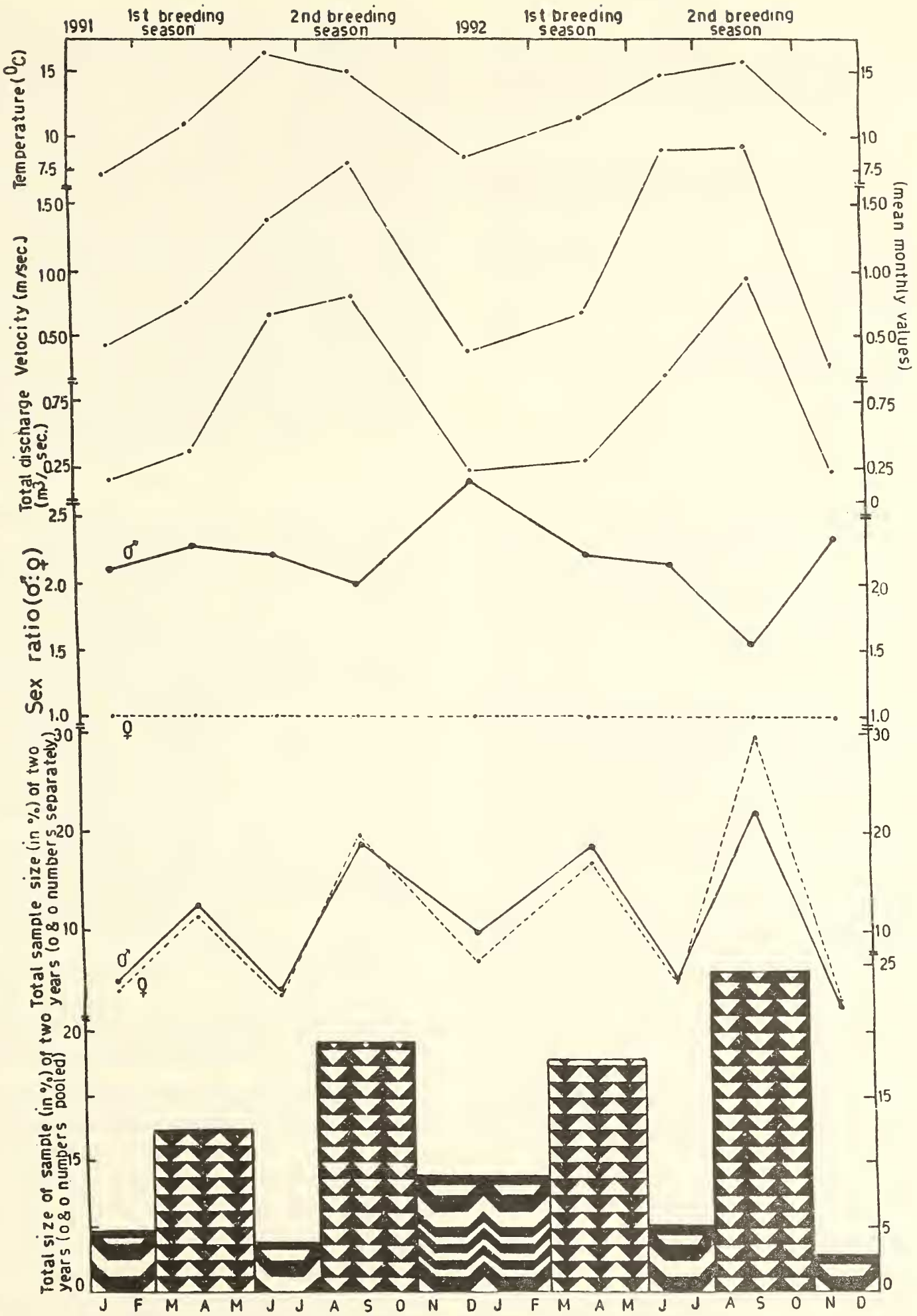

Fig. 2. Sex ratio of *Schizothorax plagiostomus* in relation to sample size (male and female numbers pooled and separately) and water parameters (total discharge, velocity & temperature) during breeding and non-breeding seasons for 1991, 1992 (in the river Mandakini)

values during extreme winters. Thus, sex ratio in *S. plagiostomus* somehow has an inverse relationship with the values of water parameters.

Discussion

Nikolskii (1980) mentioned that optimum sex ratio in nature is close to 1:1 in adult part of the population but it may be far from this in particular age and size groups; males usually predominate in younger groups because they tend to mature earlier and live less longer. Thus, optimum sex ratio may vary drastically as a result of being affected by numerous factors.

Sex composition and sex ratio of fish population have been investigated in a number of European fishes, *viz., Huso dauricus* (Soldatov 1915), North Caspian roaches (Monastyrskii 1940, *Leuciscus idus* (Soloveva 1960), coal fishes (Mironova 1961), sea perch (Freund 1961), coregonids (Titova 1962), roaches and carp beams (Demin 1962) to mention a few. However, the pattern of variation in the sex ratio is not generalised because no single factor accounts for such a change in all classes. Different factors cause the sex ratio to change in different cases. Females predominate in fishes of low fecundity such as *Pomatoschistus caucasicus* where the male is larger than the female but males are fewer in number (Koblitskaya 1961). Females also predominate in many other cases where a male produces several batches of sperms but female produces only one batch of ova. Conversely, in other cases, males predominate, e.g., *Platessa platessa* (Wimpenny 1953), *Pseudosciana corcea* (Chen Ju Fen 1962). Again, in many cases, different population of species residing in different regions exhibit different sex ratio, e.g. *Carassius auratus gibelio* in Chinese and Japanese waters has a ratio of 1:1 but in Amur river the ratio is 0.48:1 (Nikolskii 1956).

In the present investigations, the sex ratio of *S. plagiostomus* was never close to the optimum 1:1 during either breeding or non-breeding season. Males predominate throughout the year. The changes in the sex ratio seem to follow a consistent pattern, i.e. higher during the first breeding season when values of aquatic parameters of river Mandakini just begin to rise from the lowest values of extreme winter, and lowest sex ratio during second breeding season when values of water parameters would be at their peak. It may be presumed that, starting from late February onwards, the potential sexually mature brooders begin upstream pre-spawning migration from lower stretches of larger glacier-fed rivers (like Ganga, Alaknanda etc.) to their smaller glacier-fed tributaries (like the Mandakini) in the upper reaches. While doing so, the males lead this upstream migration, followed by females. Earlier arrival of male brooders changes the sex ratio drastically in local populations at a particular spawning/breeding locality. The first breeding season is followed by the non-breeding period (June, July). From July onwards, the upstream migration of potential and/or rest of brooders, especially to smaller spring-glacier fed tributaries, commences again which further alters the sex ratio to its lowest values during the second breeding season (August, September, October). It is possibly because an earlier departure of males from potential spawning/breeding sites has already started. This is the time when values of aquatic parameters touch their zenith. The breeding process of one year smoothly passes through to the next year, thus maintaining and repeating the periodicity of the process.

Higher sex ratio during the first breeding season may result from (1) late arrival of females and early arrival of males, (2) fresh recruitment of new batches of subadults into male brooders, (3) difficulties encountered by female brooders during upstream migration because of their full grown belly, and lower water discharge of the river. Otherwise the conditions are conducive for spawning and breeding as a result of rising temperature and moderate water velocity, and (4) vulnerability of females to their predators and other natural hazards. Possibly, environmental conditions during the first breeding season favour the male part of the population while females are

favoured during second breeding season.

Nautiyal (1994) found that alteration in the sex ratio of *Tor tor* is initiated by the pre-spawning migratory phase itself in the brooder population only. Moreover, at a particular spawning site, the brooder males tend to be in surplus number and stay longer; the brooder females tend to leave the spawning site soon after spawning. This causes a change in the sex ratio which has its own adaptive significance for the control mechanism of reproduction and sex composition of a reproducing population (Nikolskii 1980). More information on sex ratio and sex composition of population-related species of schizothoracids from other hillstreams would present a total picture.

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28. ON THE SPECIFIC IDENTITY OF *OMPOK BIMACULATUS* (SILURIFORMES: SILURIDAE)

(*With one plate*)

The genus *Ompok* Lacepede is currently represented by four species in the Indian region *viz. O. bimaculatus* (Bloch), *O. malabaricus* (Val.), *O. pabda* (Ham. Buch.) and *O. pabo* (Ham.